Presentation to Japanese Delegation by Office of Emergency Management

November 5, 2013

Question 1

Decision making on site-specific decontamination end-states (or “how clean is clean” issue). In the Science Fellow report, recommendation in section 2.3 indicates to develop guidance on remediation end-state. It is helpful if you could provide examples of such guideline in the US and targets of decontamination. At the same time, please let us know how you implement its guideline, especially in the challenging sites (high & low air dose rate).

EPA Protection Action Guidelines

http://www.epa.gov/radiation/docs/er/pag-manual-interim-public-comment-4-2-2013.pdf

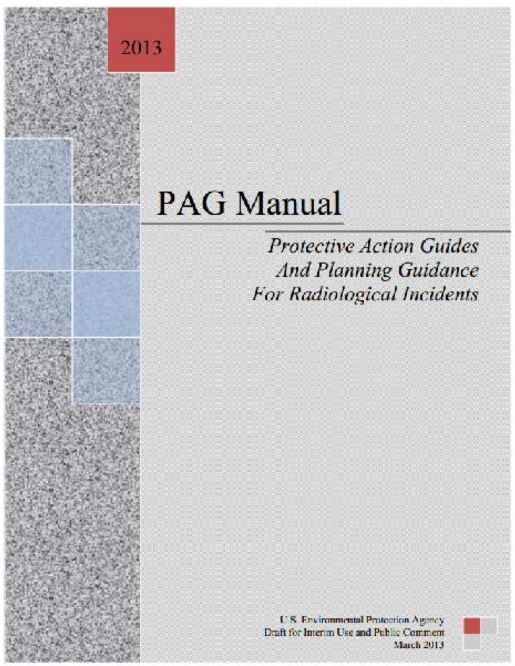


Table 1-1. Planning Guidance and Protective Action Guides for Radiological Incidents

Phase	Protective Action Recommendation	Protective Action Guide or Planning Guide
Early (Chapter 2)	Sheltering-in-place or evacuation of the public[a]	1 to 5 rem (10 mSv to 50 mSv) projected dose/4 days[b]
	Administration of prophylactic drugs KI[c]	5 rem (50 mSv) projected child thyroid dose[d] from radioactive iodine
	Limit emergency worker exposure	5 rem (50 mSv)/year (or greater under exceptional circumstances)[e]
Intermediate (Chapter 3)	Relocation of the public	2 rem (20 mSv) projected dose first year[b] Subsequent years, 0.5 rem (5 mSv)/year projected dose
	Food interdiction[f]	0.5 rem (5 mSv)/year projected dose, or 5 rem (50 mSv)/year to any individual organ or tissue, whichever is limiting
	Limit emergency worker exposure	5 rem (50 mSv)/year[b]
	Reentry	Operational Guidelines[g] (Stay times and concentrations) for specific activities (see Section 3.7)
Late (Chapter 4)	Cleanup	Brief description of planning process
	Waste Disposal	Brief description of planning process

Late Phase Guidance

KEY POINTS IN CHAPTER 4 –LATE PHASE

- PAGs will not be used to guide restoration and recovery of areas impacted by a radiological incident; rather, planning activities should include developing a process to involve stakeholders in setting priorities and determining actions. Such a process should be flexible enough to adapt to a variety of situations.
- Planning considerations for worst case scenarios are provided. Smaller radiological incidents may be well addressed by existing emergency response and environmental cleanup programs at local, state, tribal and federal levels.
- Reoccupying households and businesses should be considered in balance with progress made in reducing radiation risks through decontamination, radioactive decay and managing contaminated waste.
- Exposure limits in a range of one in a population of ten thousand (10^{-4}) to one in a population of one million (10^{-6}) excess lifetime cancer incidence outcomes are generally considered protective, though this may not be achievable after a large radiological incident. In making decisions about cleanup goals and strategies for a particular event, decision makers must balance the desired level of exposure reduction with the extent of the measures that would be necessary to achieve it, in order to maximize overall human welfare.
- Incidents that create large volumes of waste from a wide-scale radiological incident would likely overwhelm existing radioactive waste disposal capacity in the U.S.
- Following a nuclear accident, the states bear primary responsibility to identify and provide waste management options, including disposal capacity; in the event of a terrorist attack, the federal government can offer a range of assistance to state governments to identify and implement waste management options.
- Safely managing and disposing of radioactive waste will require pre-planning at all levels of government and careful coordination with stakeholders at all stages of the decision-making process.

Historic Cs-137 Clean-up Values at Sites Subject to CERCLA

	Site	Cleanup Level (Bq/g)	Cleanup Decision	Receptor	Dose- or Risk-based	Evaluation Method
Cs-137	ANL	0.86	0.15 mSv / y	-	Dose	-
	INEEL	0.42	1E-04 risk	Outdoor Worker	Risk	Sampling
	BNL	2.5	0.15 mSv and 1E-04 risk	Industrial Use	Both	Soil Sampling/ Surveys
	SRS	0.1	1E-06 risk	Future Resident	Risk	-
	SRS	0.04	1E-06 risk	Future Worker	Risk	-
	Reactor	0.23	0.15 mSv / y	Frequent Use/ Resident	Dose	Sampling

Long term remedy decisions under the CERCLA statute and regulations are driven by many factors including but not limited to national standards, state promulgated standards, if more stringent, the media where the contamination is located, short and long term remedy implementation considerations, state and public acceptances, etc. In some cases, the time frame to for these remedies to reach their remediation goals may be decades.

Other Approaches

The following slides provide approaches from other federal agencies and non-EPA organizations:

ANSI

NRC

ICRP

NCRP IAEA, ICRP, NCRP, WHO and many others recommend

- 100 mrem / yr to 2,000 mrem / yr
- That are assumed to be protective based on human studies

ANSI H13.12 Screening Levels for Clearance			
Radionuclide Group	Screening Levels (S.I. Units)	Surface Screening (Conventional Units)	Volume Screening (Conventional Units)
	Bq/cm^2 or Bq/g	(dpm/100 cm^2)	(pCi/g)
Group 1 Radium, Thorium, and Transuranics and High Dose Photon Emitters: ^{60}Co, ^{137}Cs (^{137}Ba), Am-241,	0.1	600	3 0.1 Bq/g
Group 2 Uranium and Selected High Dose Beta-Gamma Emitters: ^{192}Ir, ^{90}Sr,	1	6,000	30 1.1 Bq/g
Group 3 General Beta-Gamma Emitters:	10	60,000	300 11 Bq/g
Group 4 Other Beta-Gamma Emitters:	100	600,000	3,000 111 Bq/g
Group 5 Low Dose Beta Emitters	1,000	6,000,000	30,000 1111 Bq/g

*The above table is for illustrative purposes only. Consult the original document for all pertinent details and assumptions.

Based on a predicted dose rate of 0.01 mSv / year.

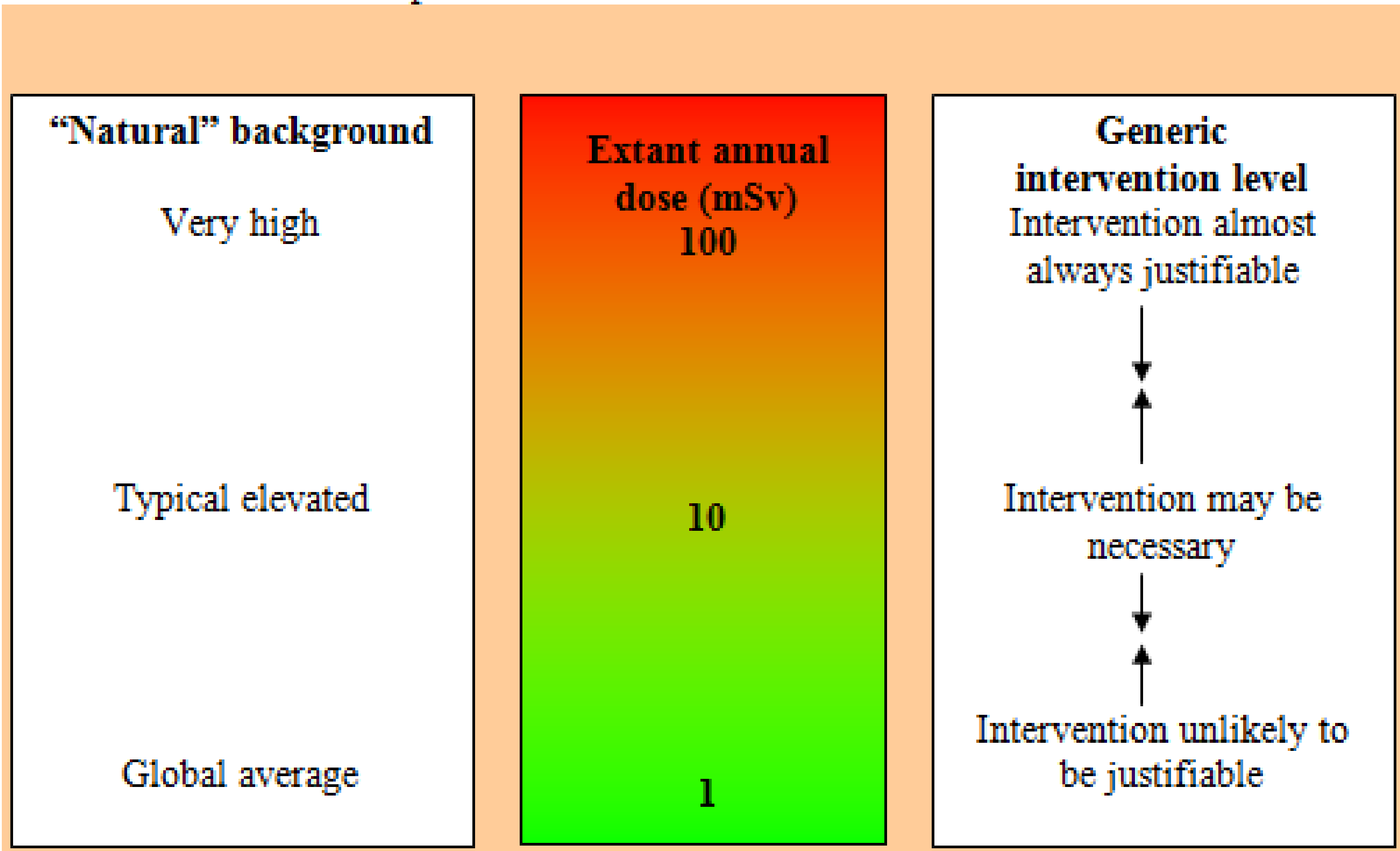
NRC Regulatory Guide 1.86/DOE Order 5400.5

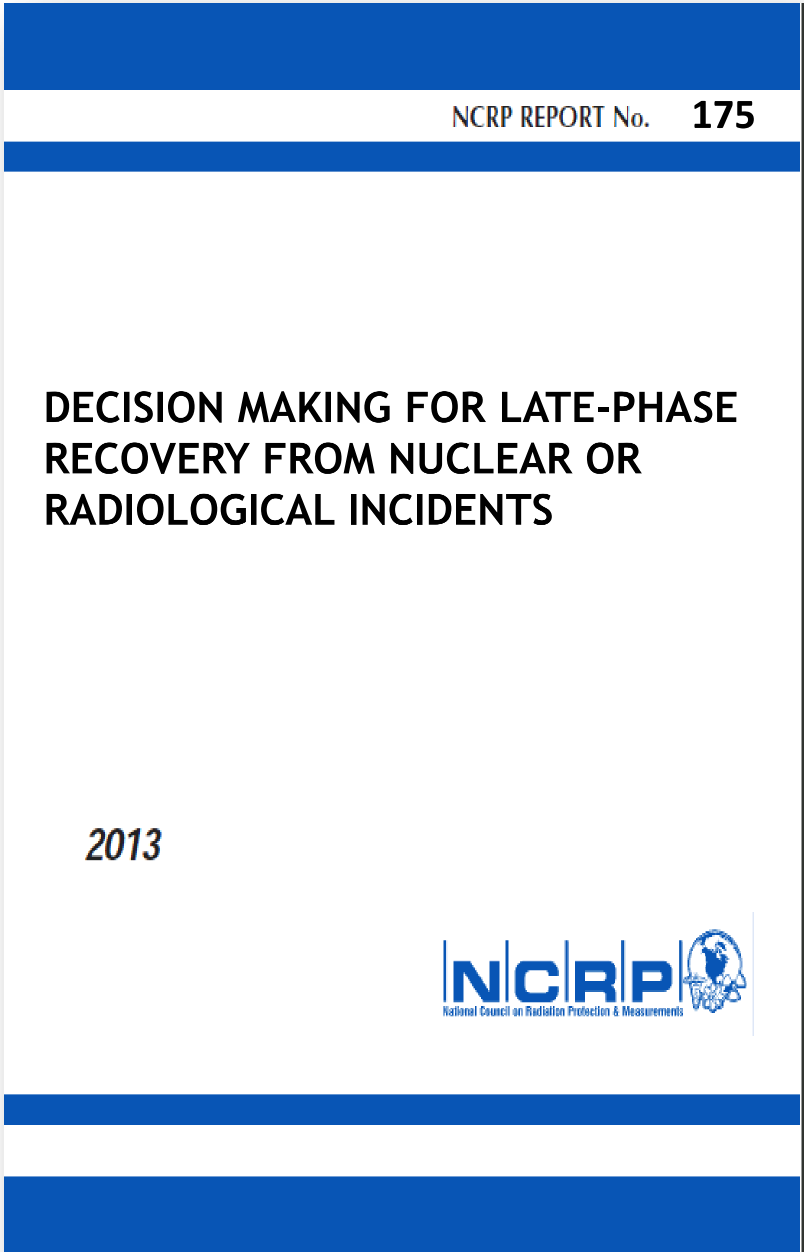
Allowable Surface Contamination			
NUCLIDE	**AVERAGE** (dpm/100 cm^2)	**MAXIMUM** (dpm/100 cm^2)	**REMOVABLE** (dpm/100 cm^2)
U-nat, U-235, U-238 and associated decay products	5000 0.83 Bq / cm^2	15000 2.5 Bq / cm^2	1000 0.2 Bq / cm^2
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 0.02 Bq / cm^2	300 0.05 Bq / cm^2	20 0.003 Bq / cm^2
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1000 0.17 Bq / cm^2	3000 0.5 Bq / cm^2	200 0.03 Bq / cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	5000 0.83 Bq / cm^2	15000 2.5 Bq / cm^2	1000 0.2 Bq / cm^2

*The above table is for illustrative purposes only. Consult the original document for all pertinent details and assumptions.

Values were based on the detection capability of the technology at the time published.

Generic Interventional Levels for Long-Term Recovery Situations
Adapted from ICRP Publication 96




NCRP REPORT No. 175

DECISION MAKING FOR LATE-PHASE RECOVERY FROM NUCLEAR OR RADIOLOGICAL INCIDENTS

2013

NCRP National Council on Radiation Protection & Measurements

S.Y. Chen,
Chairman **SC 5-1**

Illinois Institute of Technology, Chicago, IL

In 2008, DHS issued Protective Action Guides (PAGs) for Radiological Dispersal Device (RDD) and Improvised Nuclear Device (IND) incidents, providing recommendations for protection of public health in the early, intermediate, and late phases of response to an RDD or IND incident.

The current Report, expanded to include nuclear reactor accidents, provides **detailed approaches to implementing and optimizing decision making during late stage recovery for large-scale nuclear incidents. (EPA staff volunteered contributions, but this is not an EPA Product).**

Late-phase responses to nuclear or radiological incidents – issues of radiological contamination

NCRP National Council on Radiation Protection & Measurements

- Emphasis on decision making
- Emphasis on site-specific optimization
- Emphasis on addressing wide-area contamination
- Emphasis on stakeholder involvement
- Emphasis on risk communication and education

Chernobyl Nuclear Accident in Ukraine (1986)

Fukushima Event in Japan (2011)

- 9.0 Richter Scale earthquake
- Followed by over 45-foot high tsunami

Late-phase recovery: addressing a broad scope of issues

- DHS PAG Guidance (2008)
  - An "optimization" process in lieu of a pre-determined Protective Actions Guideline (PAG)
  - Existing statutory processes as starting point

- Further
  - Long-term potential health consequences are not the only consideration
  - Other priority issues include the local economy, employment, critical infrastructures, public services which demand urgent attentions
  - Decisions toward cleanup require careful deliberation through the optimization process for competing priorities of the society
  - Stakeholders an integral part

Partnering with stakeholders in decision making

Active participation by the stakeholders is an absolute necessity throughout the late-phase recovery process.

In responding to large scale of the U.S. Federal Emergency Management Agency (FEMA) began to develop a concept that involves the "**Whole Community**" in the preparedness for response.

Risk communication: gaining trust from stakeholders

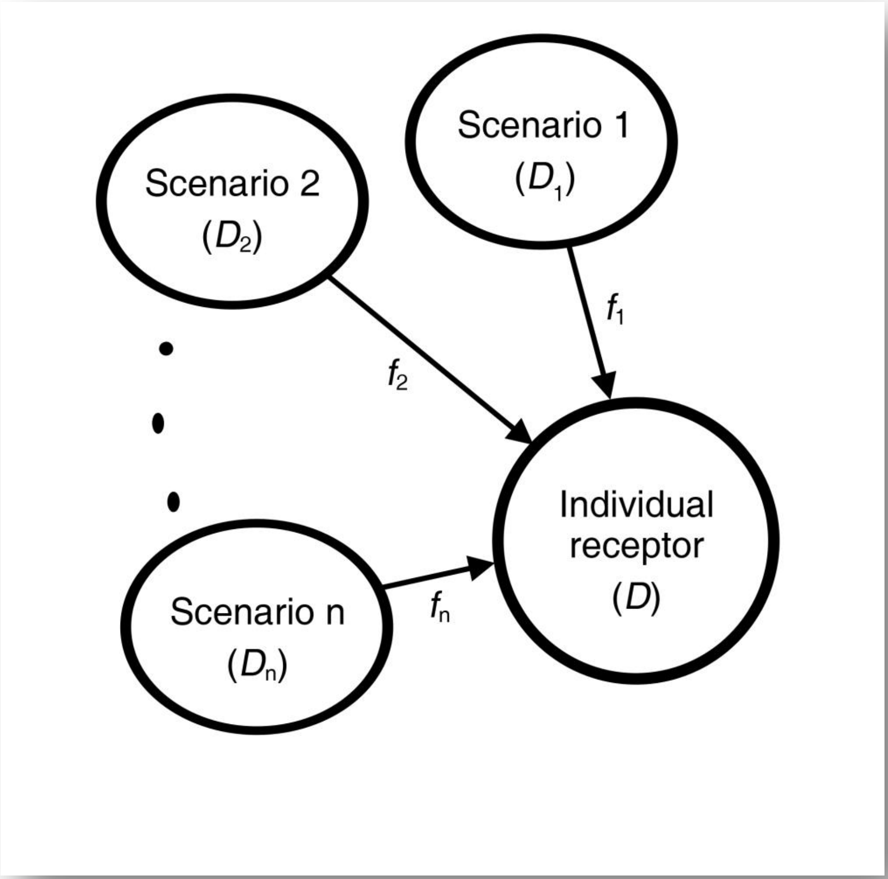
- Follow IRPA's principles for effective communication that serves to foster a close partnership with stakeholders in every stage of the site-specific optimization decision process.

- The **objective of communication** is to address the important issues involved in decision making during the recovery process:
  - transparency,
  - inclusiveness,
  - effectiveness, and
  - shared accountability.

Key to Stakeholders Outreach: Risk Management and Communication

- Risk communication is as important as the risk assessment itself.
- Even when radiation doses are low, risk communication and outreach are essential to help the public, media, authorities.
- Scientists must be willing to communicate their work to other scientists, regulators, and the public.
- Be available
- Town meetings
- Focus Groups
- Dialogues
- Engage, Empower

Individual exposure also involves multiple land-use scenarios



$$D = \sum_{i} f_i \times D_i$$

D = dose received by the individual receptor

f_i = occupancy frequency for Scenario i

D_i = dose received for Scenario i = *function* (contamination level, pathways)

An individual-related exposure from scenarios with contamination

NCRP's site-specific optimization

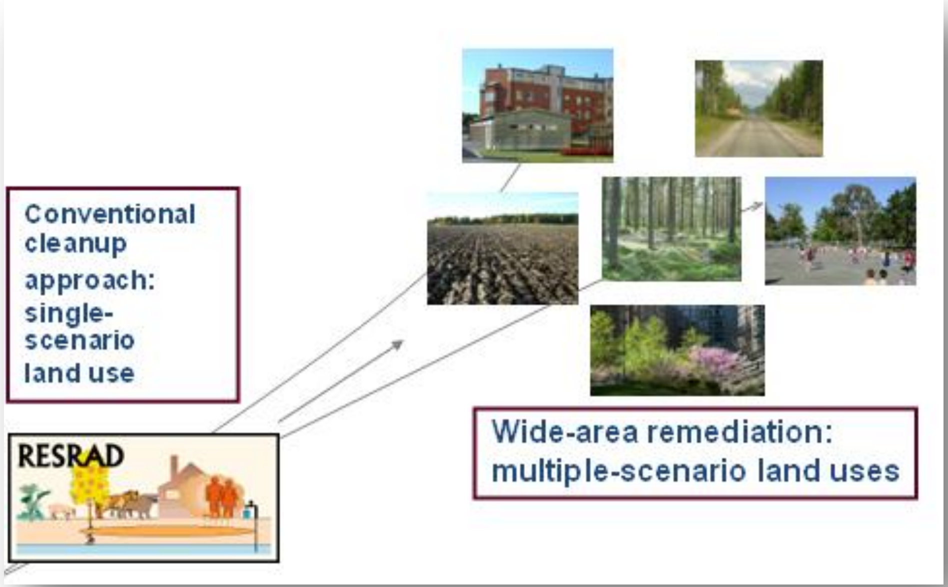
Wide-area issues: an individual-related exposure from multiple scenarios with contamination

Addressing wide-area remediation: a departure from conventional cleanup approach

Complex decision making with Iterative, graded approach In environmental remediation

Remediation also entails effective deployment of applicable technology

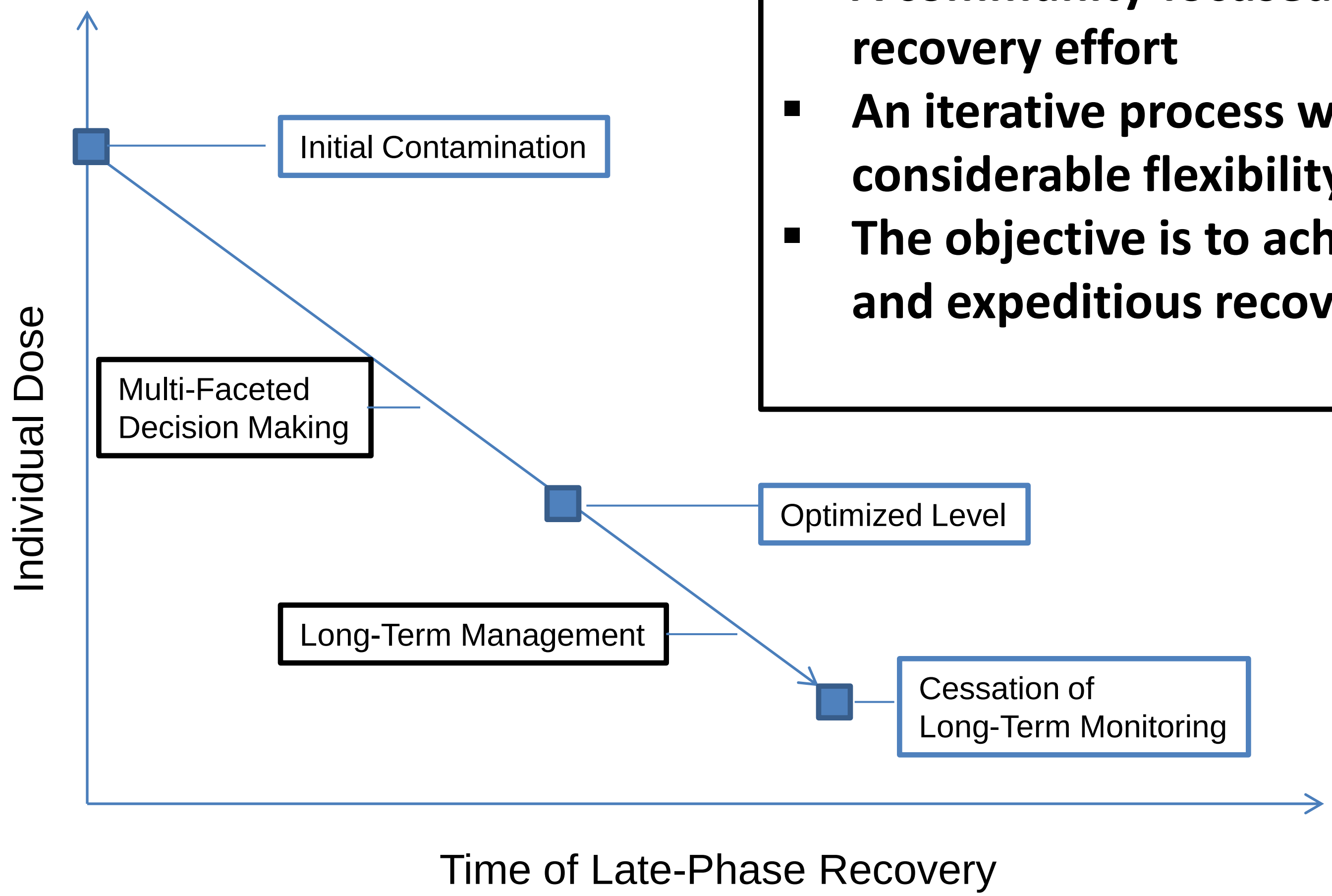
Cost-benefit analysis plays a vital role in optimizing decision making



The optimization approach focuses on dose reduction through long-term management strategy

NCRP's Optimization – a long-term strategy via continued monitoring and management

- **A community-focused recovery effort**
- **An iterative process with considerable flexibility**
- **The objective is to achieve and expeditious recovery**



About the report status

SUMMARY - Characterization of late-phase conditions/contamination

- A decision framework for late phase recovery
- Key information needed for decision making
- Principles and approach to optimization
- Relevant lessons learned from historic events and exercises
- Example scenarios to illustrate the optimization process
- Priorities for long-term monitoring
- Consolidated recommendations for late phase recovery

All comments on preliminary draft report were received by 4/15/2013. The Committee incorporated and completed the draft report in August 2013. Report is pending upon NCRP publication (to be issued as Report 175).

Short videos on Chernobyl accident & EPA preparations

Managing the Food Supply
(50 second clip)

11 Short videos

1. Lesson Learned
2. Radiation and Radioactivity
3. Types of Radiation Incidents
4. The Initial Response
5. Learning from Chernobyl Recovery
6. Reducing Risks
7. Managing Food Supply
8. Coping with Health Concerns
9. Importance of Information
10. Being Prepared
11. Conclusion

http://www.epa.gov/oem/content/community/multimedia.htm

Thinking toward long-term recovery

Typical Environmental Cleanup

site

- Background levels vary
- Limited pathways
- Contaminated Site
- “Small” area
- Typical policies
- Site-specific cleanup
- Controlled access
- Return to “normal” background
- Protect individuals
- Few Exposure Scenarios
- Risk Levels
- National guidelines
- Gov’t oversite

Large-scale Environmental Cleanup

site

- Extensive Contaminated background
- Multiple pathways contaminated, leading to recontamination
“Large” area
- Policy flexibility
- Site specific cleanup and economic impacts
- Uncontrolled access
- “New normal”, new background
- Protect population
- Multiple Exposure Scenarios
- Dose Levels and Risk levels
- National and International Guidelines

Implementing Recovery Efforts

suggestion to consider

Data fusion using cell phone and radiation detection technology

EPA does not endorse or promote products, this is for informational purposes only.

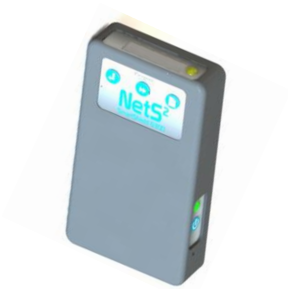
Why this technology could help?

- Builds a real-time map of contaminated areas based on people movements (Web-based access)
- Identifies hot spots, verifies cleanup, and validates other measurements
- Dose is measured vs. calculated or predicted
- Empowers the public, educates them, personalizes the recovery
- Reduces characterization costs
- Improves trust through transparency, inclusiveness, effectiveness, and shared accountability (IRPA principles)
- People will make more informed decisions about their potential exposures

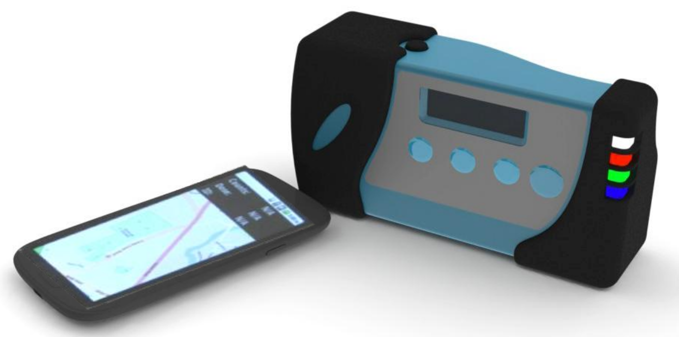
Networked Sensor System – NetS^2

- NetS^2 SmartShield = Detector + Smartphone
- Each NetS^2 unit provides alerts, location, and trajectory of any nuclear or radiological material to each node in the network
- Each NetS^2 unit automatically maps radiation in the operational area
- Each NetS^2 unit operates completely autonomously
- Base Control Unit (BCU) provides complete operational awareness and control for the entire network on a laptop

SmartShield™ G300



SmartShield™ G500 with smartphone

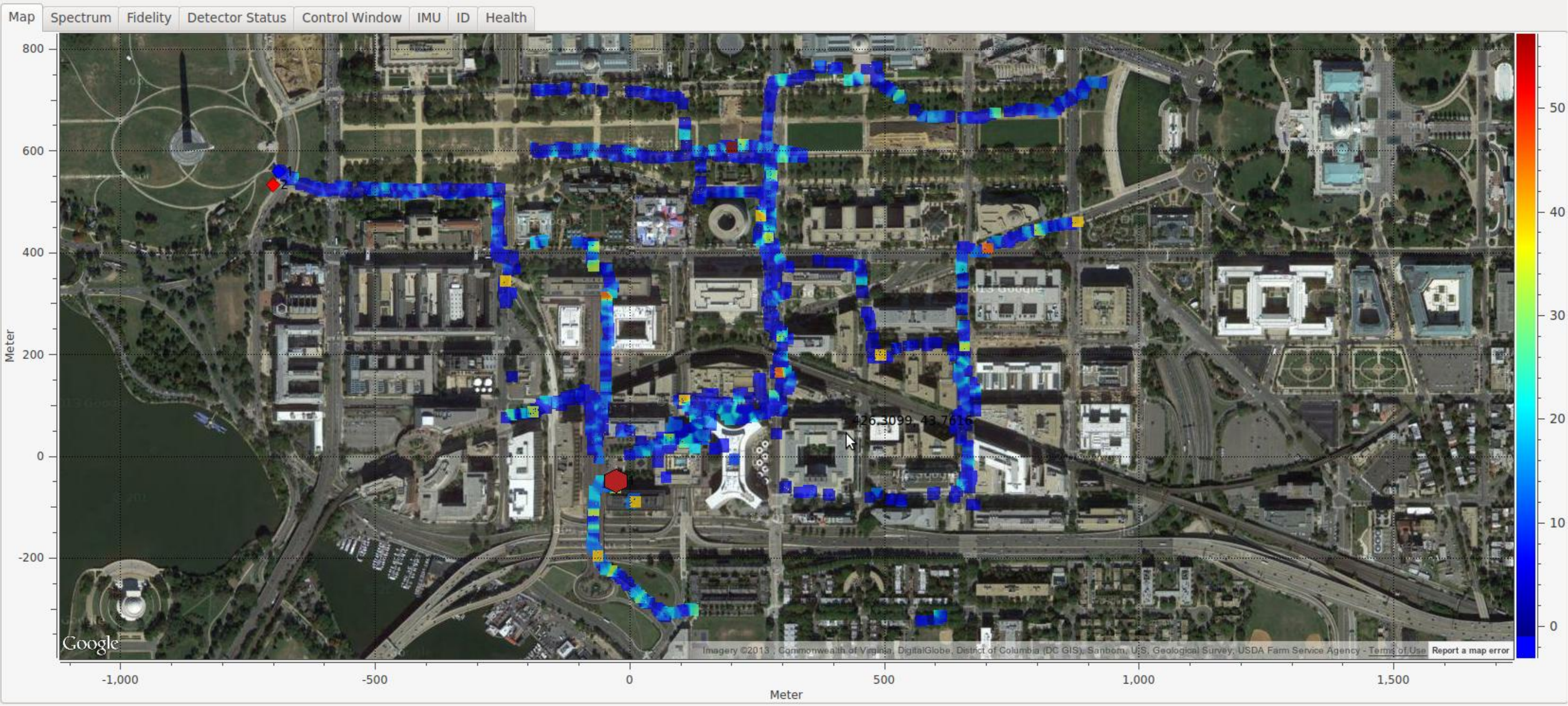


BCU with NetS^2 Mobile Command Software

EPA does not endorse or promote products, this is for informational purposes only.

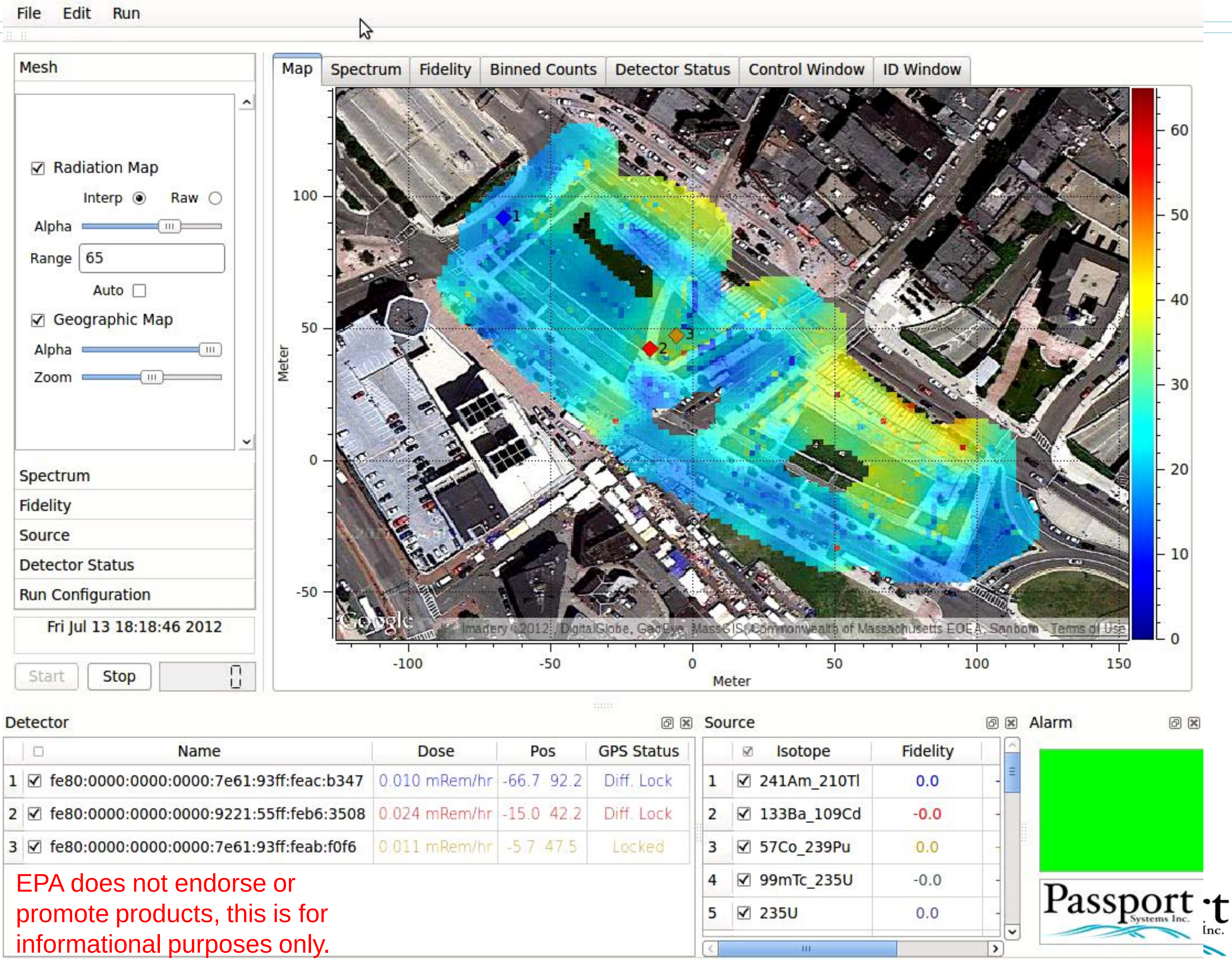
Passport Systems Inc.

Street-by-Street Search Example



- 60 minutes of pedestrian search using three operators
- Broad area maps can be accumulated and integrated in real time
- Constant monitoring of radiation background and potential alarms during normal course of activities

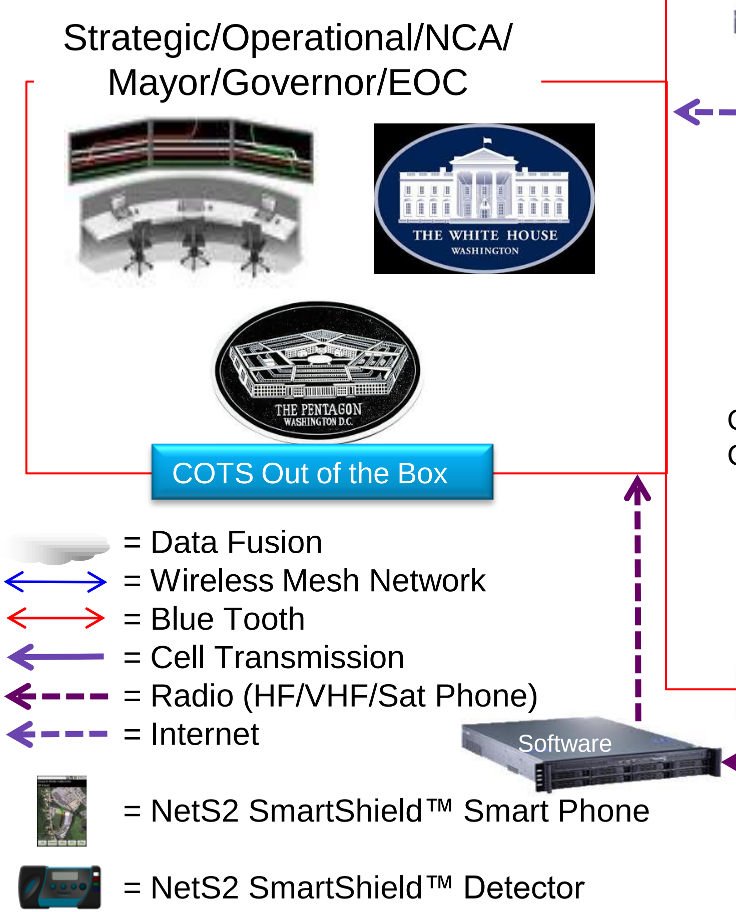
EPA does not endorse or promote products, this is for informational purposes only.

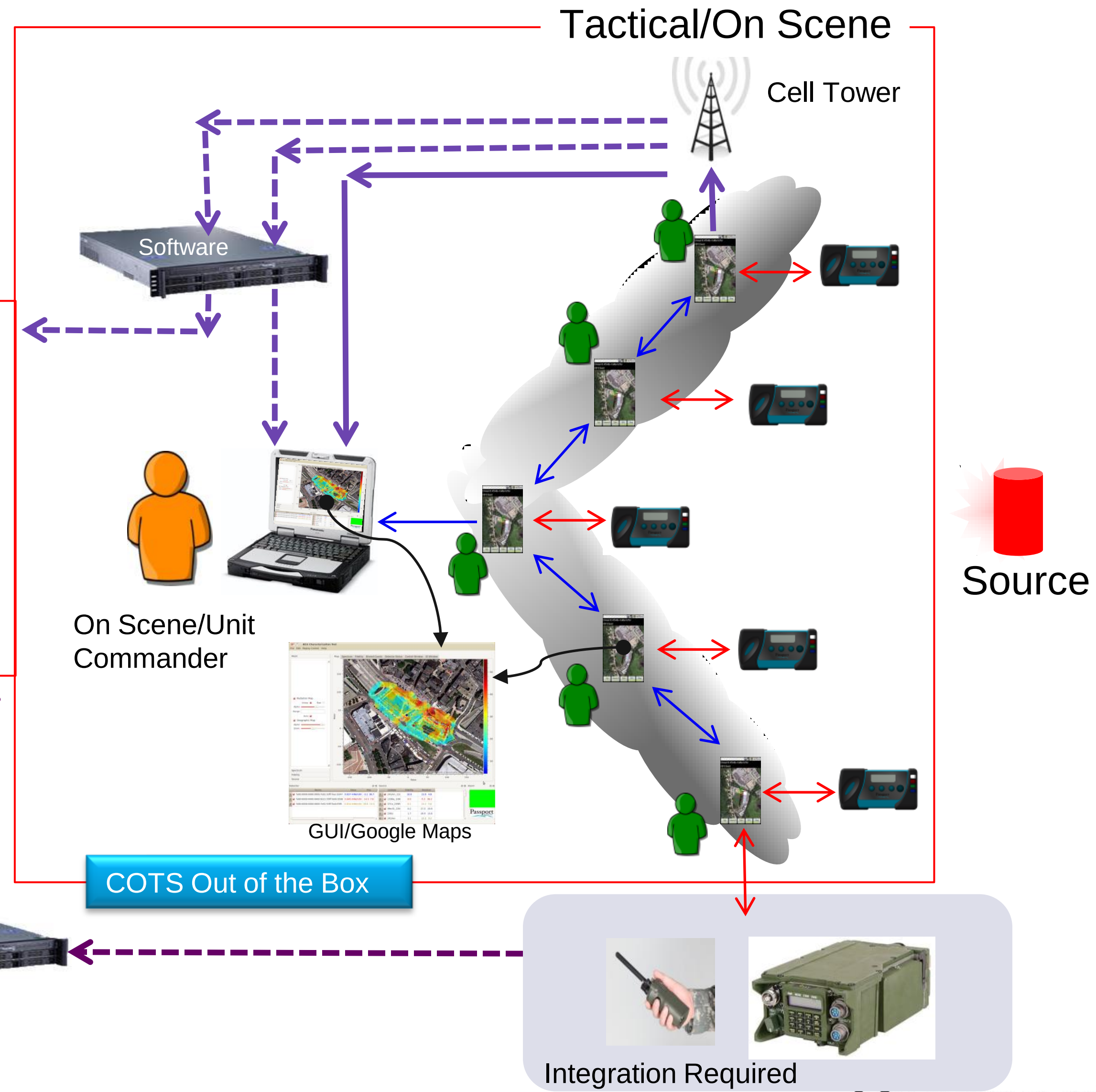


EPA does not endorse or promote products, this is for informational purposes only.

NetS² Communication Architecture

- Data network can consist of local networks, wide-area networks, or any combination
- The architecture supports full situational awareness at the operator level, mobile command level, and/or central command level





EPA does not endorse or promote products, this is for informational purposes only.

Passport Systems Inc.

Multi-Sensor Data Fusion

- Multi-sensor data fusion provides for increased system capability
  - Increased detection capability compared to individual detectors
  - Maintain a low system-wide false alarm rate
  - Enables source localization and tracking capability not available using only individual detectors
  - Temporal and spatial analysis

- Our advanced data fusion algorithms:
  - Optimize available data
  - Intelligently fuse data to ensure <u>no degradation</u> due to poor data
  - They are computationally efficient and can be run on a smartphone platform
  - They are robust to data drop-outs

- The data fusion algorithm samples multi-dimensional hypothesis space
  - Simultaneously performs detection and determines source characteristics (location and size)
  - Estimates the full probability density function consistent with all available data

Summary of Advantages

- *Geolocates the source* digitally and identifies the isotope
- Architecture can be scaled to 1000s of detectors, deployed locally or world wide
- Small, less expensive, detection technology can be used with increased sensitivity
- For Law Enforcement agencies, provides a digital record that can be replayed in court
- Can function as a dosimeter – in addition can geolocate where the dosage was received
- Full situational awareness locally and at the remote command post –same operational picture for all users
  - Background radiation map also created automatically
- All local processing – insures that individual users leverage full system potential
  - True even if the cell phone loses connectivity to the cell tower
- Belt Clip-on sized device
- Fully omnidirectional—no need to point it

EPA does not endorse or promote products, this is for informational purposes only.

Passport Systems Inc.

Disadvantages to consider

- Cost - how much? Operational and Maintenance costs? Who pays?
- QA/QC issues - how to prevent people for using the device inappropriately?
- Will people want to wear this?
- Durability - can it withstand the rigors of environmental use?
- Data management - who and how? Access to data? Control?
- Could increase people's anxiety to know they are being monitored and tracked. Could ease the minds for others.
- Privacy Issues. Volunteers? Legal considerations?
- Any impact on communications?
- Will they work indoors?
- How to ensure proper wear for comparing results?

Question 2

We are interested in some examples of implementation of these principles; what and how you explain about risk assessment process, protective approach and standard setting to the stakeholders.

Public Exposure Limits

EPA risk-range / dose and how it affects clean-up decisions

10^{-6} risk = 0.01 mSv per lifetime

10^{-4} risk = 1.25 mSv per lifetime

Lifetime" is a cumulative exposure over 30 years ***above background.*** The conversion is based on the Linear-No-Threshold Model.

"It is recognized that experience from existing programs, such as the U.S. EPA's Superfund program, the U.S. NRC's process for decommissioning and decontamination to terminate a nuclear facility license and other national recommendations may be useful in planning cleanup and recovery efforts." EPA 2013 PAG Manual, p. 51

Theory of "Recovery"

$$E = mc^6$$

E =	**efficiency**
m =	**massive amounts of**
c =	**coordination**
	communication
	collaboration
	cooperation
	cash
	courage